



## THEORETICAL REVIEW

## Behavioral economics strategies for promoting adherence to sleep interventions



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## SUMMARY

Cognitive-behavioral treatment for insomnia and continuous positive airway pressure therapy for obstructive sleep apnea are among the most efficacious sleep interventions. Unfortunately, adherence levels are disappointingly low for these interventions. Behavioral economics offers a promising framework for promoting adherence, often through relatively brief and straightforward strategies. The assumptions, goals, and key strategies of behavioral economics will be introduced. These strategies include providing social norms information, changing defaults, using the compromise effect, utilizing commitment devices, and establishing lottery-based systems. Then, this review will highlight specific behavioral economic approaches to promote patient adherence for three major sleep interventions: 1) behavioral treatment for pediatric insomnia, 2) cognitive-behavioral treatment for adult insomnia, and 3) continuous positive airway pressure for obstructive sleep apnea. Next, behavioral economic strategies will be discussed as ways to improve health care provider adherence to clinical practice guidelines regarding appropriate prescribing of hypnotics and ordering sleep-promoting practices for hospitalized inpatients. Finally, possible concerns that readers may have about behavioral economics strategies, including their efficacy, feasibility, and sustainability, will be addressed.

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## Introduction

Cognitive-behavioral treatment (CBT) for insomnia and continuous positive airway pressure (CPAP) therapy for obstructive sleep apnea (OSA) are among the most efficacious sleep interventions [1–3]. Unfortunately, adherence levels are disappointingly low for these interventions [4,5]. Comprehensive frameworks have been proposed to increase adherence to sleep interventions [6–8]. However, interventions based upon these frameworks often require multiple sessions of health care provider time and therefore sometimes are not feasible for large-scale dissemination to the substantial portion of the population with sleep difficulties.

Behavioral economics (BE) offers an alternative framework for promoting adherence, often through relatively brief and straightforward strategies. This review has four major parts. First, the assumptions, goals, and key strategies of BE will be introduced.

**Abbreviations:** BE, behavioral economics; CBT, cognitive behavioral therapy; CPAP, continuous positive airway pressure; OSA, obstructive sleep apnea; EMR, Electronic Medical Record.

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Second, this review will highlight specific BE approaches to promote patient adherence for three major sleep interventions: a) behavioral treatment for pediatric insomnia, b) CBT for adult insomnia, and c) CPAP for obstructive sleep apnea. Third, BE strategies will be discussed as ways to improve health care provider adherence to clinical practice guidelines for sleep. Fourth, possible concerns that readers may have regarding BE will be addressed.

## A brief overview of behavioral economics (BE)

Behavioral economics features two critical assumptions. First, while traditional economics presumes consumers are rational decision makers who make well-informed and appropriate choices, BE often views consumers as irrational decision makers who make poorly informed and maladaptive choices. Second, BE advocates have proposed simple interventions that promote more adaptive decision making yet do not mandate individual change. The titles of two of the most popular books on BE—Dan Ariely's *Predictably Irrational* [9] and Richard Thaler and Cass Sunstein's *Nudge* [10]—highlight these two underlying assumptions.

Considering that BE has deep roots in economics and marketing, it may be best known for helping consumers make better financial

### Glossary of terms

Behavioral economics (BE)	An interdisciplinary field based upon knowledge from marketing, psychology, and economics that assumes consumers often make maladaptive choices that can be overcome by brief and straightforward interventions.
Commitment devices	An approach to promote adherence that features an individual setting aside a tangible item such as money at the beginning of a health-focused program that must be forfeited if goals are not met by the end of the program.
Compromise effect	The impact of offering three options that may promote selection of a middle option.
Defaults	The initial option with which consumers are presented that often holds considerable weight in decision making, even if it is not in the best interest of consumers or society as a whole.
Descriptive norms	The frequency with which similar individuals hold a particular view or display a particular behavior relative to the attitudes and behavior of a specific person.
Injunctive norms	The frequency with which high-performing individuals hold a particular view or display a particular behavior relative to the attitudes and behavior of a specific person.
Lottery-based system	A reinforcement approach that features small chances of relatively large rewards as opposed to higher chances of more modest rewards.

decisions, such as increasing retirement savings or decreasing home energy bills. However, BE's relevance for improving decision making has expanded to health care. Numerous governmental and philanthropic agencies, including the United States National Institute of Health [11], the United States Department of Agriculture [12], the Bill and Melinda Gates Foundation [13], and the Robert Wood Johnson Foundation [14], have had funding announcements calling for BE interventions to address common health problems. While BE has been featured prominently for many health behaviors, including nutrition, contraception, and substance use [15–17], its relevance for promoting sleep remains largely unexplored in the scientific literature. Below are five BE strategies that have been used to influence decision making in non-sleep domains. These non-sleep domains are featured in this section because they feature leading examples of BE applications in case these approaches are eventually considered for sleep purposes.

### Providing social norms information

Because people sometimes lack information to compare their attitudes and behaviors to those of their peers, this BE strategy features providing such feedback. For example, providing positive information on what groups thought about a particular product has led to more subsequent purchases relative to withholding this information [18]. Descriptive norms and injunctive norms are two types of social norms [19]. The former refers to how often comparable individuals hold a particular view or display a particular behavior. In contrast, the latter refers to how often high-performing individuals hold a particular view or display a particular behavior.

The benefit of social norms has been demonstrated in the area of energy conservation. Because people generally have no idea how they compare to their peers in terms of household energy use, Schultz and colleagues gave low performing individuals (high energy users) descriptive norms for their neighborhood and found subsequent decreases in usage among this energy-inefficient subgroup [20]. They also found giving high-performing individuals (low energy users) emotional-laden feedback in the form of happy-face icons prevented this energy-efficient subgroup from increasing its energy usage. If this energy-efficient subgroup had increased its energy usage, it would have gravitated to the overall neighborhood mean and negated the benefits of providing social norms.

### Changing defaults

This BE strategy suggests that the initial option (“the default”) with which consumers are presented often holds considerable weight in decision making, even if the default may not be in the best interest of consumers or society as a whole. Company-sponsored retirement savings plans provide a classical example of how different defaults can influence individual decisions. When the default is not to participate and employees must opt-in to such initiatives through completing paperwork indicating their agreement to participate, employee contribution rates are disappointingly low. However, interventionists have found that changing from opt-in programs to opt-out programs—in which employees must explicitly complete paperwork indicating their refusal to participate—can greatly increase contribution rates for retirement savings programs [21]. Opt-out programs have also been found to increase cadaveric organ donation [22].

### Using the compromise effect

Individuals are often unwilling to make extreme decisions. Therefore, the compromise effect suggests that offering three options that differ on some type of dimension (e.g., price, time commitment) may promote selection of a middle “compromise” option whereas offering just two options may promote the least demanding choice [23]. For example, offering three cars priced in the inexpensive, moderately expensive, and highly expensive ranges respectively may promote consumers' selecting the moderately expensive automobile while offering just the inexpensive and moderately expensive options might promote purchases of the inexpensive automobiles. In terms of health behavior, this BE strategy of offering three levels of lifestyle changes — no change, moderate change, huge change — might promote selection of a healthy behavior in the moderate range. In contrast, offering just two treatment options — no change, moderate change — may make the latter option look unduly demanding or difficult and hence may facilitate the selection of the status quo.

### *Utilizing commitment devices*

The BE concept of loss aversion indicates that a loss of a particular size is more powerful than a gain of the identical size [24]. For example, a \$1000 cut in net annual salary causes a larger emotional reaction than a \$1000 raise in net annual salary according to this concept. Traditional economics, however, would view these two scenarios as having similar emotional valence.

Loss aversion is one of the bases for the BE strategy known as commitment devices. Here is an example of a program using commitment devices. Just prior to initiating a health promoting program, patients are voluntarily asked to put aside a certain amount of money and/or are given a baseline amount of money. However, that money must be forfeited if the health goals are not met by the end of the program. If the health goals are met, the patient keeps the amount [25]. Commitment devices differ from traditional reinforcement programs in which patients start with no financial amount but eventually earn a reward if the goals are met at the end of the program. Results of commitment devices have been encouraging for smoking cessation [26].

### *Establishing lottery-based systems*

People often overestimate the odds of low probability events occurring. This error in reasoning helps explain the huge money spent on lotteries and other forms of gambling. Loewenstein, John, and Volpp suggested that this cognitive bias can facilitate health promotion if interventionists create incentive programs that feature small chances of large rewards when adherence is demonstrated rather than higher chances of more modest rewards [27].

The potential applications of the aforementioned BE strategies for promoting sleep will be highlighted in four subsequent sections of this review.

## **BE strategies to promote adherence to behavioral treatment of pediatric insomnia**

Two separate groups of sleep experts identified extinction-based approaches as among the most efficacious treatments for insomnia in young children [28,29]. These behavioral approaches are based upon withholding reinforcement after a behavior that previously reinforced or redirecting the child to more adaptive behavior. A common reinforcer for pediatric insomnia is excessive parental attention and reassurance of the child at the beginning and/or middle of the night. Under these circumstances, sleep experts recommend ignoring—parents' provision of minimal attention to the child so that he or she does not receive inadvertent social reinforcement for non-sleep behavior—so that the child can develop self-soothing skills to sleep more independently.

Three scientifically-supported extinction approaches are as follows. First, unmodified extinction involves letting the child “cry it out” until he or she eventually falls asleep unless significant safety concerns emerge. Second, graduated extinction entails ignoring the child for progressively longer time intervals but permitting parents brief face-to-face visits to reassure the child between those intervals. Third, extinction with parental presence features the parent in the same room but a separate sleeping space as the child is ignored. Eventually, the child and parent sleep in separate rooms. A recent study indicated that extinction strategies cause no long-term harm in terms of childhood behavior problems or attachment difficulties [30]. While adherence rates for extinction treatments for pediatric insomnia have not been firmly established, parents often utilize behavioral strategies that are not consistent with these empirically supported interventions. Thirteen percent of

caregivers encountering middle of the night awakenings frequently bring the toddler to their own bed, while 35% of parents frequently give the toddler food or water under these circumstances [31].

Successfully implementing any of these extinction treatments is likely predicated on four steps: 1) parental recognition of a pediatric sleep problem (e.g., insufficient child sleep, lack of independent sleep), 2) parental awareness of extinction approaches, 3) parental willingness to try one of these approaches and 4) parental persistence in adhering to an approach despite potential drawbacks (e.g., initial child distress). These four steps are based on the Information-Motivation-Behavioral Skills Model of Adherence, which posits that awareness of a treatment regimen (Step 2), motivation to use a regimen (Steps 1 and 3), and ability to implement a regimen (Step 4) are prerequisites of adherence [32]. As outlined below, BE strategies could promote adherence to all four steps.

### *Providing social norms information*

Parents often report their child sleeps less than is typically recommended by health care professionals [33]. If parents track a child's duration of sleep and/or sleep behaviors, they could obtain feedback on their child's sleep profile relative to a large group of similarly-aged children. Parents may be more willing to recognize when sleep is problematic if they obtain feedback on such social norms. In other words, if many other parents indicated that their similarly-aged children actually achieve recommended amounts of sleep and/or that certain sleep behaviors (e.g., extended curtain calls, prolonged night awakenings) do not occur for many families, parents of children with sleep difficulties may be more likely to recognize these concerns as problematic and inquire about possible interventions.

### *Changing defaults*

Once parents identify a child as having a sleep problem worthy of intervention, best-practice guidelines suggest they learn an extinction-based approach. However, acquiring such information often may not occur. As opposed to consulting a health care provider, obtaining advice over the internet is often the default strategy for many patients dealing with health conditions in general [34] and pediatric behavioral concerns in particular [35]. Unfortunately, such information may not be consistent with the most scientifically supported treatments. For example, a Google search for “help my baby sleep” produced as one of its top results a website offering some advice contrary to extinction-based approaches [36]. Therefore, health care providers may need to change the existing default option of internet advice by proactively offering parents information on the extinction-based approaches before these caregivers begin searching on their own for sleep promoting strategies. Of course, future work is needed to establish the most beneficial ways to educate parents about the extinction-based approaches on a large scale basis. Brief counseling during well-child primary care visits or self-help materials that can be reviewed at home could be two options.

### *Using the compromise effect*

Once parents learned about extinction, they may be unwilling to implement such an intervention. In particular, parents may view these procedures as cruel due to the limited comfort they can offer the child, with unmodified extinction viewed as the cruelest because it features the most isolation [28]. Again, BE may be helpful to address this concern. Specifically, the compromise effect may help parents implement modified extinction procedures. Both

graduated extinction and extinction with parental presence may be viewed as relatively humane compromises because caregivers are permitted limited forms of contact with the child. Therefore, offering three options—unmodified extinction, a modified extinction approach such as graduated extinction or extinction with parental presence, and status quo responding that typically involves frequent parental attention and reassurance—may facilitate selection of the middle compromise approach as opposed to proposing just the second and third options. A modified extinction approach may be more acceptable to certain parents because they can reject what they may deem to be the cruelest option.

Working with parents to select a compromise approach to address pediatric insomnia may seem like such basic common sense that it does not even warrant mention. However, providers may not offer numerous options because they are too pressed for time. Alternatively, if providers view unmodified extinction as generally unacceptable to most parents, they may not offer it as an alternative against which to compare a modified extinction approach.

#### *Utilizing commitment devices*

For parents who have selected any extinction based treatment but anticipate difficulties in implementing this approach due to their own fatigue or reduced frustration tolerance at night, a commitment strategy may be appropriate. Just prior to beginning an extinction-based program, parents can voluntarily put down a certain amount of money or a desirable tangible item (e.g., clothing, shoes, recreational equipment) that will be forfeited to a charity, relative, or a friend if they fail to implement the program. Such a commitment device may foster parental adherence to implementing an efficacious behavioral strategy for pediatric insomnia.

#### **BE strategies to promote adherence to CBT for adult insomnia**

Schutte-Rodin and colleagues identified stimulus control and sleep restriction as among the two most efficacious treatments for adult chronic insomnia [37]. These strategies involve using the bed for sleeping only as opposed to reading or watching television, avoidance of naps, minimizing the amount of time one lies awake in bed, and only going to bed in a drowsy state. They also noted that good sleep hygiene (e.g., avoiding caffeine at night, getting exercise early in the day) are worthwhile antecedent management strategies although strong scientific evidence is lacking that appropriate sleep hygiene by itself will reduce adult insomnia.

While some CBT studies of adult insomnia have high adherence rates of 80% or greater [38,39], other studies have modest adherence rates of 50–70% [40–42]. These latter studies had a positive correlation between higher adherence and better outcomes [40–42]. While the CBT literature on adult insomnia has focused on documenting adherence rates and establishing their relationships to clinical outcomes, interventions for increasing adherence have received little empirical attention. An exception is Perlis and colleagues, who found that a morning dose of modafinil plus CBT improved both outcomes and treatment adherence to CBT as compared to placebo medication plus CBT [43]. The authors postulated that modafinil may decrease the daytime sleepiness that can result from the initial stage of using the CBT strategy of sleep restriction at night. Given that this medication costs several hundred dollars for a one month supply [44] and that little else is known regarding ways to promote adherence to CBT for adult insomnia, alternate strategies for promoting adherence deserve attention. Four BE strategies are discussed below as other avenues to explore.

#### *Changing defaults*

The importance of defaults has already been partially recognized in the treatment of adult insomnia. For example, maintaining a predetermined fixed wake time is a major component of sleep restriction. Unfortunately, adherence to a fixed wake time can be easily overridden with the push of the snooze button on a standard alarm clock or the unplugging of the device. Therefore, creative ways must be found to prevent this easy default from being used on one's alarm clock. The makers of Clocky—an alarm clock that automatically moves around one's bedroom—have changed the easy default of pushing a button on a stationary device [10,45]. Clocky requires that someone must leave his or her bed in order to catch the device and therefore disable the alarm, thereby increasing the likelihood that the person will fully awaken so that he or she can adhere to a prescribed sleep-wake schedule.

There may be opportunities to expand the role of defaults regarding adult insomnia. Because motion detectors can already be used on beds [46], technology might be developed so that these detectors will trigger an alarm during the day. These detectors would signal likely violations (e.g., taking naps during the day, using the bed for non-sleep purposes) of the CBT principles. Whereas the current default is for a bed to not produce an alarm during the day, a new default could be for an occupied bed to trigger an alarm during daytime hours. As technology is developed so that adults can control certain aspects of their home (e.g., lighting, temperature) remotely [47], safeguards could be implemented to prevent an adult from easily disabling an alarm on the bed during the day.

#### *Using the compromise effect*

A recent randomized trial indicated that late-day caffeine intake can reduce total sleep duration [48]. The compromise effect suggests that offering three options—eliminating all caffeine, changing caffeine use by reducing the amount or restricting to the first part of the day, and not changing caffeine intake—may precipitate some caffeine change as opposed to offer just the latter two options. Some adults may be willing to adopt the middle selection; this choice may promote sleep, as Youngberg and colleagues found that early day caffeine use likely does not interfere with nighttime sleep [49].

#### *Utilizing commitment devices and/or lottery-based systems*

Vigorous exercise has been correlated with better nighttime adult sleep [50,51]. Commitment devices, in which adults lose a pre-specified amount of money they have set aside each time they do not adhere to their exercise plans, may help adults adhere to these goals. Pedometers or electronic monitoring of gym attendance can facilitate accurate assessments of exercise. Similarly, lottery-based systems, in which adults have a small chance for a relatively large sized reward but only for time periods in which they achieved their exercise goals, may promote daytime exercise. These BE reinforcement-based strategies could also be used to promote completion of on-line CBT programs, which are self-administered interventions that have scientific support for addressing adult insomnia through helping patients learn about the aforementioned strategies of sleep restriction, stimulus control, and sleep hygiene [52].

#### **BE strategies to promote adherence to CPAP**

Research by Terri Weaver and her colleagues has indicated that 30–80% of patients prescribed CPAP fail to use the machine for a minimum of four hours per night [53,54]. A 2014 Cochrane



Collaboration review by Wozniak, Lasserson, and Smith indicated that educational, supportive, and behavioral interventions increased CPAP usage by 30–90 min per night on average [55]. Despite these encouraging results, the interventions that had positive effects on CPAP adherence had noteworthy limitations. To begin with, approximately one-quarter of the recipients of these adherence-promoting interventions remained non-adherent at post-treatment [55]. In addition, these interventions often required several nights of CPAP titration in a sleep laboratory in addition to many clinic-based or home-based sessions from health care providers [56,57]. Many insurers may refuse to cover such costly services, thereby limiting the large-scale dissemination of these programs. Furthermore, a briefer model—a two-session group intervention for CPAP adherence—had follow-up data for just one month, making the long term generalizability of the results unknown [58]. Finally, an efficacious automated telephone-based intervention for CPAP adherence required monthly discussions about facilitators and barriers for an entire year, which represents a considerable time investment that some patients may decline [59]. Given these limitations of evidence-based interventions, novel strategies for CPAP adherence deserve exploration. Four BE strategies inform alternative approaches that could reduce provider time devoted to promoting CPAP adherence.

#### *Changing defaults*

Provider monitoring of patient adherence to CPAP is likely best accomplished through prompt and frequent feedback so that side effects and attitudinal barriers can be addressed in the earliest possible fashion. Unfortunately, many CPAP machines rely on “smart cards” downloaded after 30–90 days after being placed in the home, thereby providing clinicians with considerably delayed information. Given previous work indicating that the first weeks of CPAP therapy may be pivotal in predicting adherence patterns and that many CPAP machines now contain modem or web-based interfaces for transferring adherence data in close to real-time, prompt and frequent feedback on CPAP usage is now more feasible than in the past [4,53,60]. From a BE perspective, changing the default from using machines that permit only monthly downloads of CPAP usage to using machines that permit more timely downloads would likely facilitate treatment adherence and would dovetail nicely with the other BE strategies for CPAP usage mentioned below. Providers could use their scarce time to contact just the subgroup of patients with adherence difficulties to CPAP as opposed to surveying their entire CPAP caseloads during the initial stages of treatment. In a small pilot trial, Stepnowsky and colleagues found encouraging trends suggesting that users of CPAP whose adherence data were transferred daily had greater usage relative to patients whose data were transferred monthly [61].

Krakow, Melendrez, and Haynes proposed a different default to increasing CPAP adherence [62]. They suggested changing the default from clinicians' only providing oral or written information on polysomnography results to showing the patient the video clip of his or her polysomnogram when an apnea occurred. They speculated that such a demonstration might impress upon patients the seriousness of OSA and noted that polysomnography technicians could offer such a review when physicians lack the time to walk patients through the video clip.

#### *Providing social norms information*

Roecklein and colleagues provided feedback to patients prescribed CPAP in the form of an individualized risk profile (e.g., heightened odds of car accidents or high blood pressure) associated with non-use [63]. These investigators found that this type of

feedback had medium to large effect size that failed to reach statistical significance in their small, preliminary study. Alternatively, according to the BE concept of social norms, giving a different kind of feedback — how often other patients at similar stages in the treatment process use their machines — may facilitate adherence. Low achievers—those who use the machine much less frequently than peers—can receive this feedback in an effort to either encourage persistence with existing CPAP equipment or facilitate inquiries about alternative masks and/or pressures to make CPAP more comfortable. High achievers—those who use the machine more than their peers—can receive positive emotional-laden feedback recognizing their adherence in an effort to protect against a boomerang effect that would make this subgroup regress toward the overall mean of lower usage.

#### *Utilizing commitment devices and/or lottery-based systems*

To help patients overcome the awkwardness and physical discomfort that can be greatest at the beginning of CPAP therapy, commitment devices and lottery based incentives can be used to provide financial repercussions. These financial consequences can be based upon objective adherence data gathered through web-based interfaces. Trials of financial incentives for CPAP usage has been infrequently reported in the scientific literature. In one of the rare trials, Tarasiuk and colleagues randomized patients to a low co-payment group or a larger co-payment group after each patient had a two week trial period to become accustomed to the machine and decided whether or not to make a purchase [64]. Patients from the low co-payment group had greater adherence relative to the larger co-payment group but only if they were from lower income backgrounds.

While this trial's findings may argue against loss aversion because individuals who initially paid more money had worse adherence, three important caveats should be noted. First, only self-report usage data were collected as opposed to more objective forms of adherence monitoring. Second, commitment devices were not implemented during the critical two week phase-in period as patients first became accustomed to CPAP. Over 50% of the Tarasiuk et al. sample declined to purchase the CPAP machine after the two week trial run. Therefore, this study's findings may not generalize to initial CPAP usage. Third, even if commitment devices are a not a fruitful approach for promoting CPAP adherence, another BE reinforcement strategy—lottery based systems—has not been tested. Future research is needed in the area of BE tangible reinforcement strategies to promote CPAP adherence.

#### **BE strategies to promote health care provider adherence to evidence-based sleep guidelines**

The previous three sections of this review have illustrated how BE concepts could be applied to promoting patient and parent adherence to evidence-based sleep interventions. However, optimizing sleep is dependent upon not only family adherence but also health care provider adherence to evidence-based treatment guidelines. Therefore, the present section will feature BE programs targeted at two different provider behaviors: appropriate prescribing of hypnotics and ordering sleep-promoting practices for hospitalized inpatients.

For both provider behaviors, a BE framework developed by Persell and colleagues to promote provider adherence to evidence-based guidelines will be utilized [65]. Specifically, these investigators offered three behavioral interventions for a non-sleep topic: minimizing inappropriate prescribing of antibiotics. First, they proposed accountable justifications, which make providers document in an electronic medical record (EMR) why they prescribed an antibiotic for illnesses (e.g., viral infections) that will not

respond to such a medication. Such an approach is based upon the BE principle of injunctive norms, which state that signaling providers that their decision may not adhere to best practices may promote reconsideration for present or future patients. Second, Persell and colleagues proposed electronic prompts in the EMR suggesting appropriate non-antibiotic alternatives, a BE default-based strategy that reflects the positive impact giving people the preferred option from the outset can have on their decision making. Third, these investigators proposed giving periodic feedback to each provider regarding how he or she compares to peers regarding inappropriate antibiotic prescribing, with the notion that such descriptive norms may alter the behavior of poorly performing providers. How such a three-step BE framework could be applied to foster provider adherence for sleep-related guidelines follows below.

#### *Appropriate providing of hypnotics*

While short term use of hypnotics may be useful for acute insomnia, prolonged use of hypnotics for adult insomnia is not generally recommended due to concerns about dependency and rebound insomnia after discontinuation [66]. Unfortunately, Moloney and colleagues found that “sleeplessness complaints and insomnia diagnoses increased over time [from 1993 to 2007] and were far outpaced by prescriptions for sedative hypnotics [during this same time period]. Insomnia may be a public health concern, but potential overtreatment with marginally effective, expensive medications with nontrivial side effects raises definite population health concerns” [67, p 1429]. Therefore, when prescribers write recurrent refills of these medications, a three-step BE system could be initiated through an EMR. First, providers could be asked to document in the EMR their justification for prolonged hypnotic prescriptions. Second, providers could be offered a list of alternatives to offer patients, including CBT techniques and on-line CBT programs. Third, providers could be given individual feedback on how they compare with peers regarding prolonged hypnotic prescribing. Those providers who often engage in prolonged prescribing could be offered additional training opportunities in CBT techniques for insomnia or consultation from sleep experts on individual cases. Similarly, nurses who frequently administer “as needed” hypnotics during their shifts could be part of such a three step BE program to reduce excessive hypnotic use.

#### *Ordering sleep-promoting practices for hospitalized inpatients*

In an effort to promote optimal immune function in hospitalized patients and prevent problematic post-hospitalization sleep patterns, several authors have recently called for greater attention in promoting sleep during inpatient stays [68,69]. For example, Yoder and colleagues suggested that frequent vital checks during the middle of the night might do more harm than good for low risk, medically stable patients [70]. Again, a three step BE-inspired system could promote optimal sleep during these inpatient stays. To begin with, providers could be asked to provide justification for frequent vital checks during the middle of the night for low-risk patients. In addition, providers could be given alternative schedules for vital checks or other procedures (e.g., blood draws) and reminders of the importance of sleep on immune function and overall mood. Finally, providers could be given normative feedback on how they compare to peers in regards to these sleep-promoting nighttime orders. Writing orders regarding dietary and activity restrictions occur frequently for hospitalized inpatients; perhaps orders regarding safeguards for preserving sleep should be implemented on a more routine basis as well.

#### **Possible concerns about BE and future avenues of research**

The present review has offered numerous BE strategies for promoting patient and provider adherence to sleep interventions. As readers consider the potential utility of these strategies, five concerns will likely emerge.

First, some will argue that such straightforward approaches to promoting adherence will be insufficient to promote change relative to more comprehensive models. Undoubtedly, many patients exhibiting non-adherence to sleep interventions have multifactorial difficulties reflecting a diverse array of psychological, educational, and logistic barriers. Low frustration tolerance [42], alcohol consumption [71], depressive symptoms [72], and maladaptive pre-treatment cognitions [73] regarding sleep are diverse factors linked to low adherence to CBT for adult insomnia, while problems utilizing the equipment [74], feelings of claustrophobia [75], and negative reactions from one's social network [76] reflect a wide variety of reasons for CPAP non-adherence. Complex approaches may be warranted for some patients with these types of barriers to adherence. However, for other patients simpler BE strategies may be sufficient to promote change, as was highlighted in the opening section of this review detailing how BE interventions have led to meaningful impacts in diverse arenas. Walton's review of brief psychosocial interventions (e.g., rephrasing of questions, activities lasting no more than an hour) also suggested that relatively uncomplicated interventions can promote behavior change [77]. To bolster their impact, BE strategies could be combined with one another to produce potentially larger effects as illustrated in the previous section of this review on pediatric insomnia.

Second, critics may question the feasibility of some BE approaches. Some interventions require further development of technology before implementation and evaluation of BE approaches for sleep can occur. While some BE strategies highlighted in this review could be supported by technology that already exists (e.g., commitment devices through the website [www.stickk.com](http://www.stickk.com)) [78], smart phone applications, internet sites, and EMR modifications could likely be developed for other BE strategies (e.g., defaults regarding prolonged hypnotic prescribing). Furthermore, providers and patients may be able to share financial incentives available through the Accountable Care Act, making BE reinforcement-based strategies viable [79].

Third, skeptics may caution that the short-term efficacy and adverse effects of BE interventions for sleep remain unknown. This concern appears particularly well-founded, as there is a dearth of scientific literature regarding the impact of BE strategies on sleep. The primary purpose of this review is not to convince clinicians to adopt these strategies but rather to encourage further research in this nascent area. Randomized trials comparing BE strategies (e.g., lottery-based systems) to non-BE approaches (e.g., fixed payment reinforcement programs) should be conducted before these novel approaches to improving sleep are seriously considered for widespread dissemination. In particular, lottery-based BE strategies deserve empirical attention because patient participation in such monetary-based programs could conceivably precipitate gambling in those at risk for this addictive behavior. However, given that gambling opportunities are already plentiful in many locales and that BE lottery-based systems neither require patients to use their own money nor involve huge payouts, it is unlikely that this BE strategy by itself could result in pathological gambling.

Fourth, critics may question whether practitioners will feel comfortable adopting these BE strategies. For example, clinicians may be hesitant to use the compromise effect when they feel strongly that one option is clearly the best for particular patients.

Providers should consider that patients making no change is always (at least implicitly) a third option and that a middle compromised option can represent progress towards more stringent patient behavior in the future. Furthermore, providers should be cognizant that the two compromised options highlighted in the present review—modified extinction for childhood insomnia and reducing but not eliminating caffeine use for adult insomnia—do have some empirical support and hence can be viewed as reasonable interventions to offer. Nevertheless, future work is needed to explore potential objections from clinicians in using BE approaches.

Fifth, some may wonder about the long-term impact of BE on sleep after these adherence-promoting strategies are eventually discontinued for individual patients or providers. Some literature suggests that healthy behaviors will continue after financial incentives for adherence are removed [80]. Hopefully, the natural consequences of better sleep, such as improved daytime mood and functioning, would promote enduring adherence.

### Practice points

- Clinicians may want to offer information on social norms to help certain subgroups of patients realize that their sleep practices are not optimal.
- Clinicians may wish to change defaults when existing technology (e.g., non-evidence based websites, CPAP machines that relay considerably delayed information to providers) interferes with optimal sleep practices.
- Clinicians may want to try offering three options as opposed to just two options in the hope that patients will select a middle option that represents improved sleep practices.
- Health systems may wish to utilize commitment devices or lottery-based systems to improve adherence to sleep interventions using internal financial resources and/or their own patients' financial commitments.

### Research agenda

- Examine the efficacy, acceptability, and adverse effects of providing social norms information, changing defaults, utilizing the compromise effect, and using commitment devices on adherence levels regarding extinction-based approaches for pediatric insomnia
- Examine the efficacy, acceptability, and adverse effects of changing defaults, utilizing the compromise effect, using commitment devices, and establishing lottery-based systems to increase adherence to CBT for adult insomnia
- Examine the efficacy, acceptability, and adverse effects of changing defaults, providing social norms information, using commitment devices, and establishing lottery-based systems to increase use of CPAP for obstructive sleep apnea
- Examine the efficacy, acceptability, and adverse effects of providing social norms and changing defaults on provider adherence to sleep-related treatment guidelines
- Evaluate the feasibility of BE strategies for sleep interventions from technology and cost perspectives
- Explore the long-term impact of BE strategies for sleep once they are discontinued

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